Selection of Prey by Walleyes in the Ohio Waters of the Central Basin of Lake Erie, 1985–1987

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Selection of Prey by Walleyes in the Ohio Waters of the Central Basin of Lake Erie, 1985–1987[1]

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Abstract. Walleyes (*Stizostedion vitreum vitreum*) were collected at five locations in the central basin of Lake Erie in 1985–87. The contents of the fishes' stomachs were examined to identify the species of prey. The seasonal availability of potential prey was determined from sampling with trawl tows. Food electivity indexes for young-of-the-year (YOY) and older walleyes were calculated. Electivity indexes changed monthly in YOY walleyes that consumed mostly YOY gizzard shads (*Dorosoma cepedianum*) in July and fed moderately on gizzard shads, but more on smelts (*Osmerus mordax*), in August. In September and October, YOY walleyes did not consume YOY white perch (*Morone americana*). During October, they continued to eat YOY gizzard shads moderately but consumed mostly emerald shiners (*Notropis atherinoides*). Older walleyes were highly partial to YOY gizzard shads, emerald shiners, and smelts and consumed no YOY white perch. The numbers of YOY yellow perch (*Perca flavescens*) in stomachs were limited. Prey selection by walleyes in the central basin was species-specific irrespective of abundance of prey.

Key words: Food preferences, forage base, walleyes, Lake Erie.

The commercial fishery for walleyes (*Stizostedion vitreum vitreum*) in the Ohio waters of Lake Erie collapsed in the late 1950's and early 1960's (Hartman 1973), and the species became almost nonexistent in U.S. waters of the central basin (Figure). Commercial production of walleyes in the central basin fell from a peak of 454,000 kg (1 million pounds) in 1956 to about 2,724 kg (6,000 pounds) in 1969 (Ohio Department of Natural Resources 1970). Suggested reasons for the decline are poor recruitment from overfishing and habitat degradation (Hartman 1973). Because of the threat of mercury contamination, the Ohio Wildlife Council ordered the closing of commercial fishery for walleyes in all Ohio waters of Lake Erie in 1970.

Protection of the remaining population through interagency catch quota and improvement of environmental conditions resulted in a series of strong year classes in the late 1970's and early 1980's (Nepszy et al. 1991). In the mid-1970's, a creel survey in Lake Erie by the Ohio Division of

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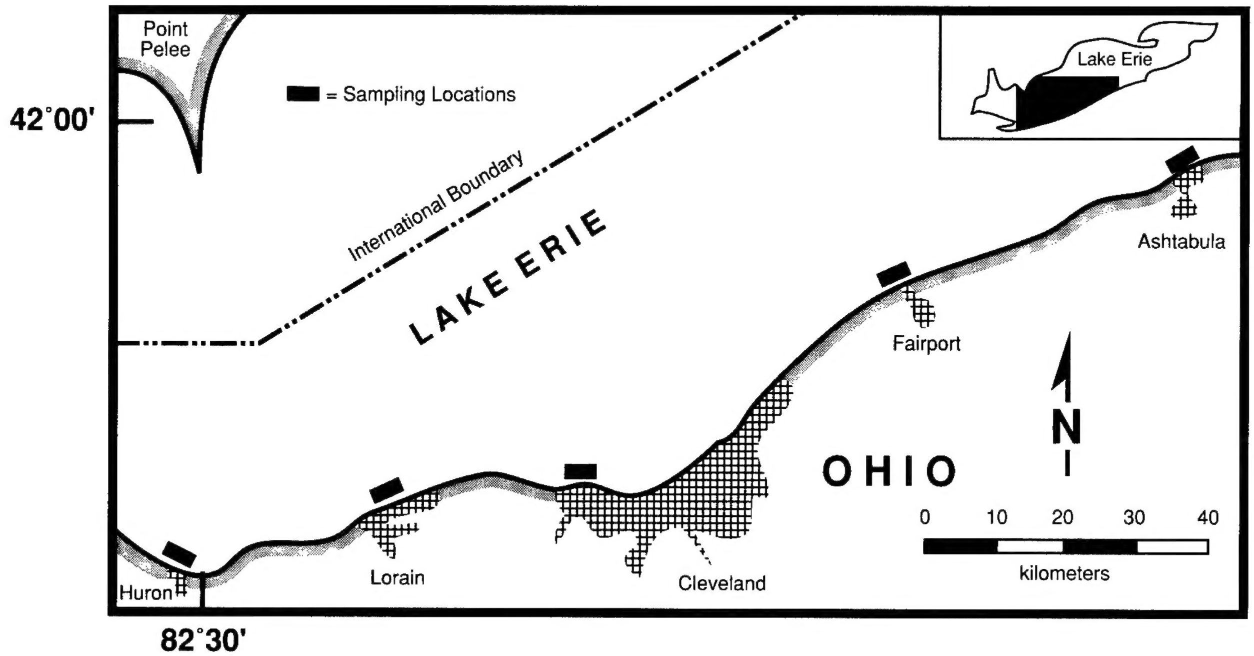

Figure. Central basin of Lake Erie showing approximate sampling locations for bottom trawling and gill netting, 1985–87.

Wildlife (1988) revealed that in 1975 anglers caught about 76,000 walleyes in the western basin. Angler catch increased rapidly to over 3.2 million by 1979 (Ohio Division of Wildlife 1988). As the sport fishery expanded in the western basin, walleye stocks in the central basin also increased (possibly from immigration), and angler catch increased from 10,000 walleyes in 1975 to 72,000 in 1980 (Ohio Division of Wildlife 1988). Between 1980 and 1984, angler catch in the western basin fluctuated between 1.6 and 3.1 million walleyes, while harvest in the central basin increased to almost 1 million in 1984 (Ohio Division of Wildlife 1988).

The increase of the walleye population in the central basin prompted us in 1985 to begin a 3-year study of the life history of the walleyes and to examine the relation of walleyes with other fish species in the central basin. Food habits of walleyes in the central basin had not been studied but must be known for development of comprehensive management of walleyes. This paper describes the food habits of young-of-the-year (YOY) and older walleyes at five locations in the central basin and compares consumed prey with available prey. Food habits of walleyes in the central basin and western basin are also compared.

Materials and Methods

Our study called for monthly sampling from June through October in 1985–87 (but mechanical problems with our vessel and budgetary and time constraints interrupted sampling in 1985 and 1986). Our sample sites were at nearly equal distances along the south shore of the central basin of Lake Erie and were adjacent to the ports of Huron, Lorain, Cleveland, Fairport, and Ashtabula (Figure). We chose the sites for their proximity to the ports (so that we could dock while gillnets were set overnight) and because the spacing allowed the best sampling effort in the allotted time. We confined the collection of walleyes and forage fishes from waters within the 12-m depth contour because our past trawling experience in the central basin revealed that the abundance of fishes is extremely limited beyond the 15-m depth contour. Rock hopper trawls with an 8-m headrope

and a cod end mesh of 13 mm (stretched measure) enabled us to collect samples from the predominantly rock substrate of the sampling sites. We made 10-min trawl tows at trawlable areas in depths of 3–12 m within 4 km of the harbor mouth. Trawlable areas were those over which a trawl could be towed without regularly getting snagged on boulders. The same locations were used for each collection.

We used gillnets to capture walleyes from the bottom strata of the 5-m and 10-m depth contour of each sampling site during April through July 1986 when the abundance of walleyes that we captured with trawls was low. One gillnet was fished at each depth and each net consisted of one 30.5-m panel in five mesh sizes (6.4, 7.6, 8.9, 10.2, and 11.4 cm stretched measure). We set nets during late afternoon and retrieved them the following morning. We assumed that the stomach content of walleyes in gillnet samples was as representative of the prey composition as the stomach content of walleyes in trawl hauls.

Catches were sorted to species and age group and counted. We recorded total length (TL) and collected a scale sample for aging. We preserved stomachs in 10% formalin. We considered fishes, other than walleyes, of ≥2.0 cm potential prey of walleyes. We identified food organisms to the lowest possible taxonomic level and measured them volumetrically by water displacement in a 10-mL graduated cylinder with an accuracy of 0.1 mL. Items with a volume of less than 0.05 mL are listed as trace. Contribution of various prey items was presented as percent of total volume of stomach content and percent frequency of occurrence.

With the electivity index (E), we measured food selection (Ivlev 1961) by walleyes with the equation $E = (r_i - P_i)/(r_i + P_i)$, where r_i = percentage frequency of occurrence of identifiable fish species in a stomach, and P_i = percent of that species in the forage segment of the trawl catches from which the walleye stomachs were obtained. Electivity values vary from +1 (prey in stomachs but not in trawl catches) to −1, (prey in trawl hauls but not in stomachs). A value of 0 indicates neither selection nor rejection of that forage species by walleyes.

Results

Prey included YOY gizzard shads (*Dorosoma cepedianum*), white perch (*Morone americana*), white bass (*Morone chrysops*), yellow perch (*Perca flavescens*), YOY and yearling rainbow smelts (*Osmerus mordax*), and all age classes of trout-perch (*Percopsis omiscomaycus*), emerald shiners (*Notropis atherinoides*), and spottail shiners (*N. hudsonius*; Table 1).

Seasonal Availability of Potential Prey

In June 1987, trout-perch dominated samples at most locations (Table 1). Other major portions of the catch were emerald shiners at Huron and smelts at Cleveland.

The abundance of captured prey in July 1986 and 1987 reflected variability between years and locations and within seasons (Table 1). In 1986, trawl hauls at Huron contained mainly gizzard shads and, albeit fewer, yellow perch. Catches at Lorain consisted primarily of white perch and trout-perch, and yellow perch and trout-perch were about equally abundant at Cleveland. Yellow perch and spottail shiners made up almost the entire catch at Fairport, whereas white perch and yellow perch dominated catches at Ashtabula. During August of all three years, YOY white perch were the most abundant species in samples at most sampling sites.

In 1985, smelts were the most numerous species in samples from Fairport; YOY white bass, the most numerous species in samples from Ashtabula; and white perch, the most numerous species in samples from Lorain. Catches during October of all 3 years showed that YOY white perch were generally the largest portion of the potential forage. Gizzard shads were also a major portion in samples from Huron in 1985 and in samples from Lorain and Cleveland in 1986.

Abundance of Walleyes

During 1985–87, we captured a total of 865 walleyes in trawl hauls (Table 1): 471 YOY, 354

Table 1. *Potential prey of walleyes (*Stizostedion vitreum vitreum*), expressed in numbers and (percentages), in trawl hauls and the total number of captured YOY and yearling walleyes at various locations in the central basin of Lake Erie, 1985–1987.*

Location	Total catch	Shad	Smelt	Trout-perch	White perch	White bass	Emerald shiner	Spottail shiner	Yellow perch	Walleye YOY	Walleye Year	Walleye II+
August 1985												
Huron	3,996	130 (3.3)	6 (0.2)	504 (12.6)	2,442 (6.11)	618 (15.5)	0	134 (3.4)	162 (4.0)	43	14	0
Lorain	1,056	0	8 (0.8)	128 (12.1)	856 (81.1)	0	0	0	64 (6.1)	16	3	0
Cleveland	5,491	0	80 (1.5)	41 (0.8)	4,944 (90.0)	296 (5.4)	0	2 (0.1)	128 (2.3)	1	8	0
Fairport	919	1 (0.1)	618 (67.3)	10 (1.1)	51 (5.5)	204 (22.2)	0	29 (3.2)	6 (0.7)	0	5	0
September 1985												
Lorain	702	6 (0.9)	8 (1.1)	87 (12.4)	539 (76.8)	29 (4.1)		5 (0.7)	28 (4.0)	10	5	0
Cleveland	491	4 (0.8)	21 (4.5)	40 (8.1)	184 (37.4)	222 (45.1)	4 (0.8)	4 (0.8)	12 (2.4)	9	1	0
Fairport	10,208	8 (0.1)	8,451 (82.8)	124 (1.2)	844 (8.3)	733 (7.2)	16 (0.2)	32 (0.3)	0	0	5	0
Ashtabula	1,036	0	29 (28)	0	8 (0.8)	974 (91.0)	8 (0.8)	16 (1.5)	1 (0.1)	12	6	1
October 1985												
Huron	427	113 (26.5)	1 (0.2)	11 (2.6)	294 (68.9)	5 (1.2)	0	0	3 (0.7)	23	4	2
Lorain	115	3 (2.6)	36 (31.3)	33 (28.7)	28 (24.4)	4 (3.5)	0	8 (7.0)	3 (2.6)	11	0	0
Cleveland	187	5 (2.7)	16 (8.6)	18 (9.6)	118 (63.1)	20 (10.7)	3 (1.6)	7 (3.7)	0	24	2	0
Fairport	340	0	21 (6.2)	17 (5.0)	264 (77.7)	20 (5.9)	1 (0.3)	16 (4.7)	1 (0.3)	2	4	1
Ashtabula	182	2 (1.1)	62 (34.1)	6 (3.3)	19 (10.4)	82 (45.1)	0	10 (5.5)	1 (0.6)	0	2	0
July 1986												
Huron	545	365 (62.0)	2 (0.4)	6 (1.1)	4 (0.7)	43 (7.9)	0	0	125 (22.9)	0	0	0
Lorain	732	0	136 (18.6)	208 (28.4)	316 (43.2)	16 (2.2)	0	4 (0.6)	52 (7.1)	15	5	0
Cleveland	939	0	24 (2.6)	332 (35.4)	163 (17.4)	64 (6.8)	0	3 (0.3)	353 (37.6)	84	10	0
Fairport	136	0	4 (2.9)	2 (1.5)	0	0	0	36 (26.5)	94 (69.1)	1	11	0
Ashtabula	1,352	48 (3.6)	104 (7.7)	16 (1.2)	697 (51.6)	0	0	11 (0.8)	476 (35.2)	49	5	0
August 1986												
Huron	919	330 (35.9)	20 (2.2)	108 (11.8)	252 (27.4)	4 (0.4)	108 (11.8)	20 (2.2)	77 (8.4)	43	6	5
Lorain	250	12 (4.8)	12 (4.8)	14 (5.6)	134 (53.6)	34 (13.6)	14 (5.6)	14 (5.6)	16 (6.4)	7	1	1
Cleveland	1,740	232 (13.4)	161 (9.3)	32 (1.8)	692 (39.8)	408 (23.4)	24 (1.4)	38 (2.2)	152 (8.7)	39	0	0
Fairport	2,956	141 (4.8)	561 (19.1)	193 (6.5)	1,396 (47.2)	13 (0.4)	212 (7.2)	21 (0.7)	419 (14.2)	20	9	0
Ashtabula	495	0	183 (37.1)	83 (16.7)	62 (12.5)	0	3 (0.6)	2 (0.4)	162 (32.7)	6	14	0

Table 1. *Continued.*

Location	Total catch	Shad	Smelt	Trout-perch	White perch	White bass	Emerald shiner	Spottail shiner	Yellow perch	Walleye YOY	Walleye Year	Walleye II+
October 1986												
Huron	824	43 (5.2)	0	24 (2.9)	695 (84.3)	7 (0.9)	0	7 (0.9)	48 (5.9)	8	22	10
Lorain	501	320 (63.9)	39 (7.8)	2 (0.4)	118 (23.6)	0	8 (1.6)	9 (1.8)	5 (1.0)	7	0	1
Cleveland	1,100	364 (33.1)	32 (2.9)	16 (1.5)	584 (53.1)	12 (1.1)	68 (6.2)	8 (0.7)	16 (1.5)	6	0	1
Fairport	2,353	144 (6.1)	57 (2.4)	0	362 (15.4)	158 (6.7)	1,608 (68.3)	24 (1.0)	0	7	1	1
Ashtabula	4,665	127 (2.7)	3,524 (75.5)	17 (0.4)	35 (0.8)	251 (5.4)	674 (14.5)	30 (0.6)	7 (0.2)	12	5	0
June 1987												
Huron	1,243	0	1 (0.1)	44 (3.5)	0	0	1,197 (96.3)	1 (0.1)	0	0	10	1
Lorain	32	0	0	18 (56.3)	0	0	2 (6.3)	12 (37.5)	0	0	2	1
Cleveland	106	0	40 (37.7)	55 (51.9)	0	0	0	11 (10.4)	0	0	53	0
Fairport	231	0	21 (9.1)	206 (89.2)	0	0	0	4 (1.7)	0	0	0	0
Ashtabula	565	0	13 (2.3)	184 (32.6)	0	0	361 (63.9)	7 (1.2)	0	0	1	0
July 1987												
Huron	926	0	240 (25.9)	52 (5.6)	590 (63.7)	0	21 (2.3)	23 (2.5)	0	0	6	0
Lorain	150	0	8 (5.3)	62 (41.3)	64 (42.7)	0	0	10 (6.7)	6 (4.0)	0	8	0
Cleveland	108	0	2 (1.8)	41 (38.0)	50 (46.3)	0	0	0	15 (13.9)	1	4	2
Fairport	30	0	2 (6.7)	3 (10.0)	10 (33.3)	0	5 (16.7)	10 (33.3)	0	0	18	0
Ashtabula	20	0	1 (5.0)	2 (10.0)	4 (20.0)	0	9 (45.0)	1 (5.0)	3 (15.0)	0	6	1
August 1987												
Huron	20	1 (5.0)	1 (5.0)	6 (30.0)	11 (55.0)	0	1 (5.0)	0	0	3	3	0
Lorain	177	0	1 (0.6)	13 (7.3)	156 (88.1)	0	1 (0.6)	3 (1.7)	3 (1.7)	5	6	2
Cleveland	7	0	0	0	5 (71.4)	2 (28.6)	0	0	0	1	44	3
Fairport	15	0	0	0	6 (40.0)	0	0	9 (60.0)	0	0	12	0
Ashtabula	0	0	0	0	0	0	0	0	0	0	41	0
September 1987												
Huron	96	3 (3.1)	2 (2.1)	6 (6.3)	48 (50.0)	10 (10.4)	3 (3.1)	8 (8.3)	16 (16.7)	2	6	0
Fairport	53	0	2 (3.8)	21 (39.6)	8 (15.1)	3 (5.7)	8 (15.1)	11 (20.8)	0	0	2	0
Ashtabula	14	0	7 (50.0)	0	0	3 (21.4)	0	2 (14.3)	2 (14.3)	0	1	0

Table 1. *Continued.*

Location	Total catch	Shad	Smelt	Trout-perch	White perch	White bass	Emerald shiner	Spottail shiner	Yellow perch	Walleye		
										YOY	Year	II+
					October 1987							
Huron	45	1 (2.2)	9 (20.0)	8 (17.8)	12 (26.7)	2 (4.4)	12 (26.7)	1 (2.2)	0	2	19	4
Lorain	14	1 (7.1)	4 (28.6)	3 (21.4)	0	0	4 (28.6)	1 (7.1)	1 (7.1)	0	0	2
Cleveland	116	5 (4.3)	9 (7.8)	15 (12.9)	28 (67.2)	2 (1.7)	1 (0.9)	5 (4.3)	1 (0.9)	2	0	0
Fairport	18	0	0	0	16 (88.9)	0	0	2 (11.1)	0	0	1	0
Ashtabula	59	0	42 (71.2)	2 (3.4)	0	1 (1.7)	7 (11.9)	7 (11.9)	0	0	0	0
Total	48,702	2,410	14,527	2,813	17,159	4,240	4,383	618	2,458	471	354	40

yearlings, and 40 age II+ individuals. Young of the year in samples varied from 16 in 1987 to 304 in 1986. Usually, more YOY were in samples from Huron, Lorain, and Cleveland than in samples from Fairport and Ashtabula. Numbers of captured yearlings per year ranged from 59 in 1985 to 206 in 1987. They were usually more abundant in samples from Cleveland, Fairport, and Ashtabula than in samples from Huron and Lorain.

Stomach Contents of Young-of-the-year Walleyes

A total of 151 YOY walleyes contained food (Table 2). Five species of identifiable prey fishes—white perch, yellow perch, gizzard shads, rainbow smelts, and emerald shiners—were in stomachs of YOY walleyes in 1985 and 1986. In July, smelts composed 80 to 96% of the stomach contents by volume and occurred in 78 to 87% of the stomachs (Table 2). Gizzard shads and emerald shiners were the only other identifiable prey in July. Smelts continued to be numerous in stomachs in August—they were in 50 to 86% of the stomachs and made up 33 to 67% of the total volume. White perch were in 21 to 33% of stomachs and composed up to 47% of the volume of the stomachs of walleyes in samples from Huron and Fairport. Gizzard shads were in only 17% of the stomachs of walleyes in samples from Cleveland but composed up to 47% of the volume of the stomachs of walleyes in samples from Huron and Fairport. Gizzard shads were in only 17% of the stomachs of walleyes in samples from Cleveland but were 67% of the food volume. The small number of stomachs with food (9) in September contained primarily YOY white perch (71–80% of the total volume) and some yellow perch. In 1986, gizzard shads were in 17 to 27% of the stomachs. Stomachs of YOY walleyes in October 1985 contained primarily smelts, white perch, and gizzard shads. In October 1986, emerald shiners prevailed in stomachs of walleyes—they were in 50 to 100% of the stomachs and made up between 51 and 100% of the total stomach volume. Other stomach content of YOY walleyes in July through October included the European zooplankter *Bythotrephes cederstroemi* (<3% volume). Samples in July also contained a few (<2% volume) *Daphnia* and *Chironomus* pupae in up to 30% of the stomachs.

Stomach Contents of Older Walleyes

Food of 305 yearling and older walleyes became more diversified as the summer progressed (Table 3). Rainbow smelts were the only identifiable item in eight stomachs in April. In May, smelts were in 38 to 93% of the stomachs that contained food and were 54 to 98% of the identifiable volume. White perch were consumed to a limited extent. *Chironomus* pupae were in 31% of the stomachs in samples from Cleveland. Yearling and older walleyes in samples from Huron in June contained limited amounts of white perch (9% by volume). Walleyes in samples from Lorain had consumed white perch (43% by volume) and freshwater drums (*Aplodinotus grunniens*; 26% by volume). Smelts were the only prey species (71% by volume) in stomachs of walleyes from Cleveland, and spottail shiners were the only prey species (15% of volume) in stomachs of walleyes from Ashtabula. Invertebrates such as pupae of *Chironomus* spp. and *Leptadora* spp. and cladocerans composed over 90% (by volume) of the contents of stomachs in samples from Huron. Stomachs that were collected in July of each year contained primarily white perch. At each sampling site, the frequency of white perch in stomachs ranged from 6 to 47%, and the total volume was from 11 to 99%. Samples from Ashtabula in July contained very diversified combinations of items including five fish species and remains of *Bythotrephes* spp. and mayflies. *Bythotrephes* spp. were plentiful in stomachs of walleyes from Lorain; they were in 44% of the stomachs that contained food and composed 11% of the total food volume. Walleye stomachs in August contained gizzard shads at all locations. Their frequency ranged between 11 and 80% and was 13 to 98% by volume. *Bythotrephes* spp. were a prominent item in stomachs of samples from Ashtabula and were 25% of volume of stomach contents in 60% of the stomachs. Stomach samples in September contained mainly smelts in a range of 35 to 99% by volume and gizzard shads in a range of 4 to 98% by percent volume.

Table 2. *Monthly prey of YOY walleyes* (Stizostedion vitreum vitreum)*, as percent of total food volume and percent frequency of occurrence (in parentheses), in trawls at various locations in the central basin of Lake Erie, 1985–1986.*

Food item	Huron	Lorain	Cleveland	Fairport	Ashtabula
July 1986					
Sample size	0	13	18	1	15
Gizzard shad	—[a]	—	—	—	20 (7)
Rainbow smelt	—	96 (85)	85 (78)	—	80 (87)
Emerald shiner	—	—	7 (6)	—	—
Fish remains	—	4 (8)	7 (17)	Tr (100)	Tr (7)
Bythotrephes	—	Tr (15)	—	—	Tr (7)
Daphnia	—	—	—	—	Tr (13)
Chironomus pupae	—	Tr (8)	—	—	Tr (27)
Insect remains	—	—	—	—	Tr (7)
August 1986					
Sample size	6	0	6	14	0
White perch	47 (33)	—	—	24 (21)	—
Gizzard shad	—	—	67 (17)	10 (7)	—
Rainbow smelt	53 (50)	—	33 (66)	67 (86)	—
Fish remains	Tr (17)	—	Tr (17)	—	—
September 1985					
Sample size	0	4	5	0	0
White perch	—	71 (25)	80 (40)	—	—
Yellow perch	—	—	10 (20)	—	—
Fish remains	—	29 (75)	10 (40)	—	—
October 1985					
Sample size	10	8	22	1	0
White perch	13 (10)	18 (13)	8 (5)	100 (100)	—
Yellow perch	—	—	5 (5)	—	—
Gizzard shad	78 (40)	—	—	—	—
Rainbow smelt	—	18 (25)	20 (23)	—	—
Emerald shiner	—	—	20 (9)	—	—
Fish remains	9 (50)	64 (63)	45 (50)	—	—
Bythotrephes	Tr (30)	—	2 (9)	—	—
October 1986					
Sample size	1	2	6	8	11
White perch	100 (100)	—	—	—	—
Gizzard shad	—	—	27 (17)	26 (13)	46 (27)
Rainbow smelt	—	—	—	—	3 (9)
Emerald shiner	—	100 (100)	63 (50)	74 (88)	51 (73)
Fish remains	—	—	10 (33)	—	—

[a] — = no data.

Table 3. *Monthly prey of age ≥ I+ walleyes* (Stizostedion vitreum vitreum)*, as percent of total food volume and percent frequency of occurrence (in parentheses), in trawl hauls and gillnets at various locations in the central basin of Lake Erie, 1985–1987.*

Food item	Huron	Lorain	Cleveland	Fairport	Ashtabula
			April 1986		
Sample size	1	0	0	0	7
Rainbow smelt	—[a]	—	—	—	95 (86)
Fish remains	100 (100)	—	—	—	5 (43)
			May 1986 and 1987		
Sample size	1	3	16	3	15
White perch	100 (100)	—	—	—	43 (7)
Rainbow smelt	—	—	98 (38)	63 (66)	54 (93)
Fish remains	—	—	1 (25)	37 (100)	3 (67)
Chironomus pupae	—	Tr (100)	1 (31)	—	—
Insect remains	—	—	Tr (13)	—	—
			June 1986 and 1987		
Sample size	8	5	9	1	6
White perch	9 (13)	43 (20)	—	—	—
Rainbow smelt	—	—	71 (22)	—	—
Freshwater drum	—	26 (20)	—	—	—
Spottail shiner	—	—	—	—	—
Fish remains	—	30 (60)	(29) (67)	—	15 (17)
Bythotrephes	—	—	Tr (33)	Tr (100)	85 (33)
Chironomus pupae	13 (100)	Tr (20)	—	—	Tr (33)
Cladocerans	70 (13)	—	—	—	—
Leptadora	9 (13)	—	—	—	—
			July 1986 and 1987		
Sample size	8	18	7	6	16
White perch	99 (38)	33 (6)	—	11 (47)	63 (25)
Gizzard shad	—	—	33 (14)	—	9 (13)
Yellow perch	—	4 (6)	—	—	2 (13)
Rainbow smelt	—	29 (67)	—	—	4 (13)
Emerald shiner	—	—	—	—	12 (13)
Fish remains	1 (50)	23 (44)	67 (86)	89 (83)	9 (44)
Bythotrephes	Tr (38)	11 (44)	—	—	1 (25)
Chironomus pupae	Tr (13)	1 (17)	—	—	—
Mayfly remains	—	—	—	—	Tr (6)
			August 1985, 1986, and 1987		
Sample size	20	18	15	32	5
White perch	—	70 (28)	17 (13)	51 (16)	—
Gizzard shad	98 (80)	13 (11)	57 (20)	25 (31)	55 (20)
Rainbow smelt	—	—	—	14 (22)	—
Emerald shiner	—	3 (6)	7 (7)	—	—
Fish remains	2 (30)	13 (56)	19 (67)	9 (31)	19 (40)
Bythotrephes	—	—	—	Tr (9)	25 (60)
Chironomous pupae	—	Tr (6)	Tr (7)	—	—
Digested material	Tr (10)	Tr (6)	—	Tr (3)	—

Table 3. *Continued.*

Food item	Huron	Lorain	Cleveland	Fairport	Ashtabula
		September 1985 and 1987			
Sample size	7	2	1	10	18
White perch	7 (14)	—	—	—	—
Gizzard shad	16 (14)	98 (50)	—	4 (10)	—
Rainbow smelt	35 (24)	—	—	77 (60)	99 (94)
Emerald shiner	—	—	—	2 (10)	—
Fish remains	33 (71)	2 (50)	100 (100)	15 (60)	1 (11)
Bythotrephes	—	—	—	2 (2)	—
		October 1985, 1986, and 1987			
Sample size	15	10	8	4	10
White perch	—	—	1 (13)	—	48 (10)
Gizzard shad	86 (80)	88 (60)	60 (88)	51 (50)	10 (20)
Rainbow smelt	—	—	19 (25)	—	3 (10)
Yellow perch	3 (7)	—	—	—	—
Emerald shiner	—	6 (20)	15 (25)	47 (50)	30 (40)
Fish remains	11 (7)	5 (70)	5 (25)	2 (25)	10 (50)
Digested material	—	—	—	Tr (10)	Tr (10)

[a] — = no data.

White perch were in stomachs of walleyes from only one location, Huron, and were only 7% by volume. During October, gizzard shads were again the most numerous prey. They were in stomachs from all five locations and ranged in frequency from 20 to 85% at 10 to 88% by volume. Emerald shiners were also frequent prey in stomachs of walleyes from four locations and ranged in frequency from 20 to 50%.

Food Selection of Walleyes

Electivity index values of YOY walleyes in samples of 1985 and 1986 (Table 4) varied monthly but in general were low for white perch. Indexes were high for YOY gizzard shads (+0.64 to +0.93) in July 1986. Emerald shiners were in stomachs of walleyes in gillnet samples from Cleveland but not in trawl hauls. In August 1986, indexes of YOY walleyes were low for gizzard shads (+0.12 to +0.19) but high for smelts (+0.64 to +0.92). Indexes for white perch varied from weak (+0.09) to a negative value (−0.39) during August. The small sample of YOY walleye stomachs (9) from September 1985 showed a low preference for white perch (−0.02 to −0.51). However, the large sample of YOY walleye stomachs (69) in October of 1985 and 1986 showed that white perch continued to be infrequent prey (+0.10 to −0.86). In October 1986, indexes for gizzard shads remained varied (−0.35 to +0.82), whereas indexes for emerald shiners ranged from +0.12 to +0.97.

Stomachs of all samples of age 1 and older walleyes in 1985 to 1987 revealed high indexes for gizzard shads, emerald shiners, and smelts and low values for white perch and yellow perch (Table 5). Samples of age 1+ walleyes in June 1987 (Table 5) were few, and white perch were in only one stomach. Stomach samples of July 1986 and 1987 revealed a high index for gizzard shads (+0.69 to +1.00) and a varied index for white perch (−0.32 to +0.33). At each site in August of each year, indexes were high for gizzard shads (+0.33 to +1.00), whereas indexes for white perch remained low (−0.37 to −0.57). In August 1987, emerald shiners in stomachs of walleyes from Lorain and Cleveland resulted in high indexes (+0.84 and +1.00). The three most common prey species in stomachs of all walleyes—gizzard shad, smelt, and emerald shiner—continued to have high indexes in the samples that were collected in September 1985 and in September 1987. The only exception was a value of −0.05 for rainbow smelts in stom-

Table 4. *Electivity indexes of various forage fishes by YOY walleyes (*Stizostedion vitreum vitreum*) in the central basin of Lake Erie, 1985 and 1986.*

Location	Number of stomachs	Gizzard shad	Rainbow smelt	White perch	Emerald shiners	Yellow perch
			September 1985			
Lorain	4	—[a]	—	-0.51	—	—
Cleveland	5	—	—	-0.02	—	+0.76
			October 1985			
Huron	10	+0.20	—	-0.75	—	—
Lorain	8	—	-0.11	-0.30	—	—
Cleveland	22	—	+0.58	-0.86	+0.68	+1.00[b]
Fairport	1	—	—	+0.10	—	—
			July 1986			
Lorain	13	+0.64	—	—	—	—
Cleveland	18	+0.93	—	—	+1.00	—
Ashtabula	15	+0.84	—	—	—	—
			August 1986			
Huron	6	—	+0.92	+0.09	—	—
Cleveland	6	+0.12	+0.75	—	—	—
Fairport	14	+0.19	+0.64	-0.39	—	—
			October 1986			
Huron	1	—	—	+0.09	—	—
Lorain	2	—	—	—	+0.97	—
Cleveland	6	-0.35	—	—	+0.78	—
Fairport	8	+0.36	—	—	+0.12	—
Ashtabula	11	+0.82	-0.79	—	+0.67	—

[a] — = no data.
[b] +1.00 = prey identified in stomachs but not present in trawl hauls.

Table 5. *Electivity indexes of various forage fishes by age ≥ I+ walleyes (*Stizostedion vitreum vitreum*) in the central basin of Lake Erie, 1985–1987.*

Location	Number of stomachs	Gizzard shad	Rainbow smelt	White perch	Emerald shiners	Yellow perch
			August 1985			
Huron	11	+0.93	—[a]	—	—	—
Lorain	3	+1.00[b]	—	—	—	—
Cleveland	7	+1.00	—	-0.51	—	—
Fairport	3	—	-0.01	—	—	—
			September 1985			
Lorain	2	+0.96	—	—	—	—
Fairport	8	+1.00	-0.05	—	+0.97	—
Ashtabula	18	—	+0.94	—	—	—

Table 5. *Continued.*

Location	Number of stomachs	Gizzard shad	Rainbow smelt	White perch	Emerald shiners	Yellow perch
			October 1985			
Huron	5	+0.58	—	—	—	—
Cleveland	2	—	+0.89	—	—	—
			July 1986			
Lorain	5	—	+0.04	+0.33	—	—
Ashtabula	10	+0.69	+0.13	−0.13	—	−0.56
			August 1986			
Huron	7	+0.33	—	—	—	—
Fairport	9	+0.91	—	−0.37	—	—
			October 1986			
Huron	7	+0.86	—	—	—	—
Lorain	1	+0.22	—	—	—	—
Cleveland	1	+0.50	—	—	—	—
Fairport	2	—	—	—	+0.18	—
Ashtabula	5	+0.87	—	—	+0.61	—
			June 1987			
Huron	8	—	—	—	—	—
Cleveland	7	—	−0.12	+1.00	—	—
			July 1987			
Huron	8	—	—	−0.25	—	—
Lorain	16	—	—	—	—	+0.33
Cleveland	6	+1.00	—	—	—	—
Fairport	6	—	—	+0.17	—	—
Ashtabula	6	—	—	−0.32	−0.19	—
			August 1987			
Huron	2	+0.81	—	—	—	—
Lorain	15	+1.00	—	−0.46	+0.84	—
Cleveland	8	+1.00	—	—	+1.00	—
Fairport	20	+1.00	+1.00	−0.57	—	—
Ashtabula	5	+1.00	—	—	—	—
			September 1987			
Huron	7	+0.64	—	−0.56	+0.81	—
			October 1987			
Lorain	9	—	—	—	−0.44	—
Cleveland	5	—	—	−0.54	+0.96	—
Ashtabula	4	—	−0.48	+1.00	+0.36	—

[a] — = no data.

[b] +1.00 = prey identified in stomachs but not present in trawl hauls.

achs of walleyes from Fairport in September 1985. With few exceptions at Lorain and Ashtabula, indexes in October of each year were high for gizzard shads, smelts, and shiners (Table 5).

Discussion

In our study, YOY and older walleyes in the Ohio waters of the central basin of Lake Erie exhibited a species-specific selection of prey that was irrespective of prey abundance. Soft rayed fishes were usually selected over spinous species with the exception of spottail shiners and trout-perch.

Young-of-the-year walleyes fed primarily on rainbow smelts, gizzard shads, and emerald shiners and, to a limited extent, on white perch, but not on spottail shiners or trout-perch. Conversely, Parsons (1971), Knight et al. (1984), and Hartman (1989) reported spottail shiners to be a major food item in western basin Lake Erie walleyes. No reason can be given for the absence of spottail shiners in stomachs of walleyes in the central basin. In Lake of the Woods, Minnesota, trout-perch were the second most abundant prey species in trawl hauls but, as in our study, were not eaten by YOY walleyes (Swenson and Smith 1976). Maybe walleyes do not find trout-perch palatable. Young-of-the-year white bass were abundant in trawl hauls in 1985 but were not in the stomachs. Walleyes may have avoided white bass because of their dorsal and anal spines. Young-of-the-year yellow perch were abundant in some trawl hauls but were rarely in YOY walleye stomachs. Parsons (1971) reported that prey of YOY and older walleyes in western Lake Erie during 1959 and 1960 was determined by the relative abundance of forage fishes of a preferred size. He identified the yellow perch as an important forage species that was 46% (by volume) of the identified food items in YOY walleye stomachs in July. During his study, spottail and emerald shiners became increasingly more important to walleyes as the year progressed and yellow perch grew larger. The consumption of emerald shiners, but not spottail shiners, by YOY walleyes during our study also increased in October when they became a selected prey. Young-of-the-year white perch were the most numerous forage species in trawl hauls, but YOY walleyes either ate none or only a few. Hartman (1989) reported YOY white perch as one of the principal prey items of YOY walleyes in western Lake Erie. Perhaps the large walleye population in the western basin is forced to prey on white perch because of a lack of preferred prey, whereas less abundant walleyes in the central basin can be more selective for prey type.

Our study revealed that yearling and older walleyes in the central basin ate smelts, YOY gizzard shads, and white perch during early summer; gizzard shads and white perch in summer; and smelts, gizzard shads, and emerald shiners during fall. Parsons (1971) found that yearling walleyes in western Lake Erie fed on spottail and emerald shiners in the spring and summer and on alewives (*Alosa pseudoharengus*) in the fall. Knight et al. (1984) found that food selection had changed by 1981; walleyes were distinctly less size-selective and seasonal diets closely followed changes in availability of forage fishes and certain prey preferences. They found that older walleyes ate age-1 emerald and spottail shiners in spring but switched to age-0 gizzard shads and alewives in summer and fall. Hartman (1989) reported that in 1986 and 1987 walleyes (300–399 mm TL) in the western basin ate primarily clupeids during summer and fall and selected shiners (*Notropis*) during June and July. The food of walleyes larger than 400 mm TL was dominated by clupeids from August through November. *Morone* spp. became an important prey of fry from June to August and shiners during June and July.

We concluded that the preferred prey of walleyes in the central basin were YOY gizzard shads, smelts, and emerald shiners. However, the reduced abundance of these species may be harming the walleye population. During 1985–86, smelts and emerald shiners were absent from many trawl hauls and thus presumed unavailable to walleyes. Even though we considered these fishes pelagic, we usually captured them in bottom trawls. Young-of-the-year gizzard shads grow so fast that by fall many are too large as prey for walleyes (Knight et al. 1984). Knight et al. (1984) found that YOY and older walleyes selected fishes of less than 90 mm TL throughout the year. During our study, a shift in electivity from gizzard shads to emerald shiners happened in October (Tables 4 and 5), probably because of the increase in the size of gizzard shads. Because of poor re-

cruitment in some years (U.S. Fish and Wildlife Service, Sandusky Biological Station, Sandusky, Ohio, unpublished data), gizzard shads are not an abundant forage item. They were very abundant in trawl catches from August to October 1986, but in 1987, gizzard shads contributed little to the forage base. The synchrony of availability of the three major prey species—gizzard shad, smelt, and emerald shiner—at a size that walleyes consume might become a limiting factor in the expansion of the walleye population in the central basin. The large population of white perch might provide a buffer forage species if a reduction in the abundance of preferred prey occurs. In Oneida Lake, Forney (1974) found that walleyes of over 20 cm in length selected young white perch as well as smaller walleyes when the density of yellow perch, the preferred prey, declined.

Alewives, a former major species in the central basin of Lake Erie in the 1960's, have declined substantially in abundance. Bowman (1974) reported that during surveys in the central basin in 1966, alewives composed over 50% of the catch. In the 1960's, alewives were a major species in the central basin of Lake Erie, but since then have declined substantially in abundance (U.S. Fish and Wildlife Service, Sandusky Biological Station, Sandusky, Ohio, unpublished data). We rarely captured alewives during our present study. Alewives were the major food (66 and 91% by number) for yearling walleyes in the western basin of Lake Erie in September and October 1960 (Parsons 1971). Knight et al. (1984) and Hartman (1989) combined gizzard shads and alewives under clupeids and listed them as a major prey of walleyes in their food studies. In Lake Erie, alewives do not grow as large or as fast as gizzard shads and may therefore provide a more desirable forage if and when other preferred species are scarce or absent. Managers should consider the reintroduction of this species into the central basin as a supplemental forage species for the expanding walleye population.

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